The Future for Strategic Planning of Healthcare Infrastructure

RES – Hospitals

Toward Hospitals at Zero Emissions

A New Dimensions for Strategic Planning

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Italian Society for Healthcare Engineering and Architecture

SIAIS

Climate change is one of the great challenges of the 21st century. Its most severe impacts may still be avoided if efforts are made to transform current energy systems. **Renewable energy sources** have a large potential to displace emissions of greenhouse gases from the combustion of fossil fuels and thereby to mitigate climate change. If implemented properly, renewable energy sources can contribute to social and economic development, to energy access, to a secure and sustainable energy supply, and to a reduction of negative impacts of energy provision on the **environment and human health**

From: Special Report on Renewable Energy Sources and Climate Change Mitigation (SRREN)

Intergovernmental Panel on Climate Change (IPCC)

HOSPITALS

There are **15,000** Hospitals

In EUROPE

They have a relatively high

Energy intensity

Consequently they are responsible

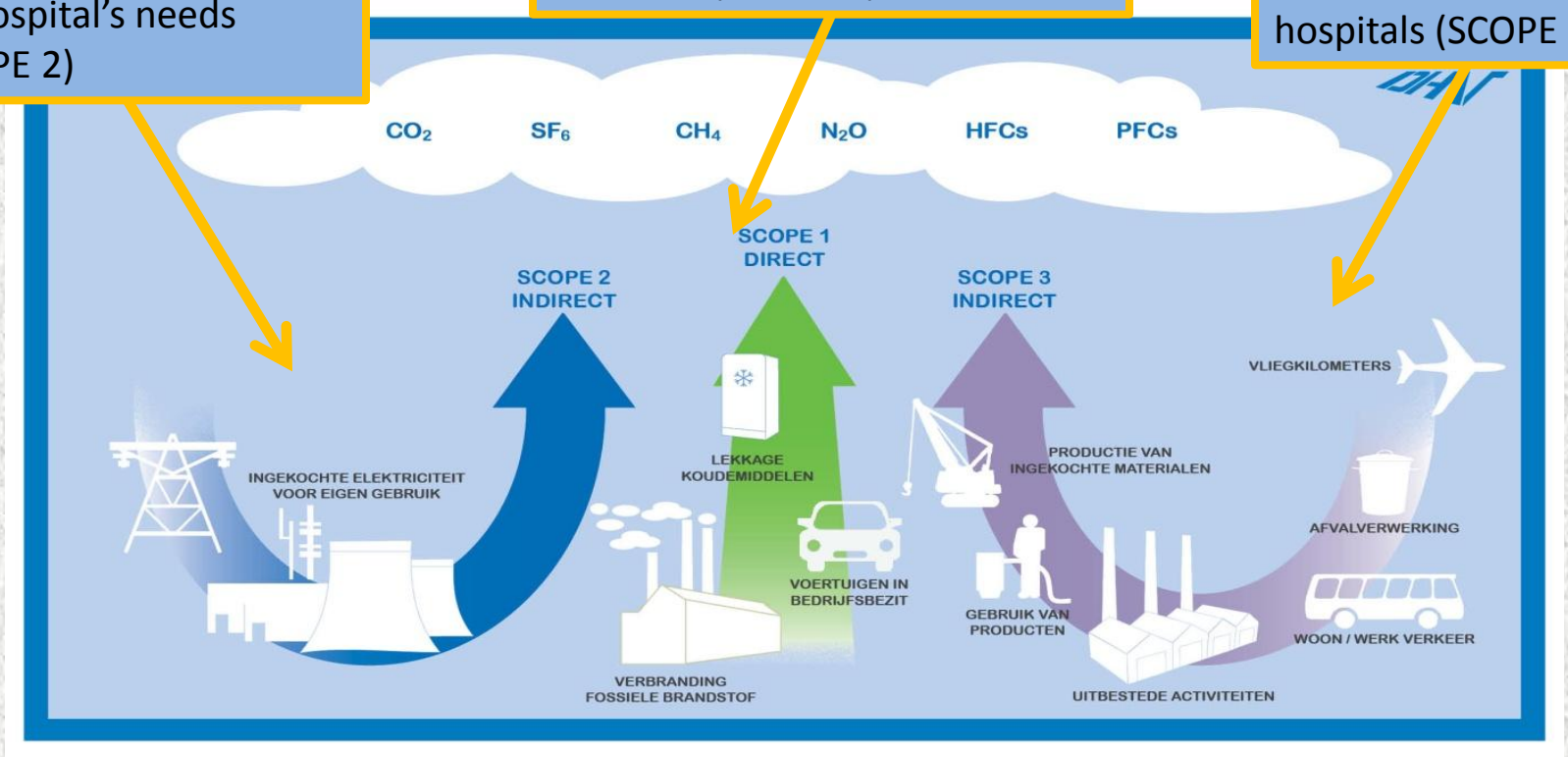
For a high production of CO2

GREENHOUSE EMISSIONS HOSPITAL RELATED

Production of electricity and head/cold by others for hospital's needs (SCOPE 2)

Emissions produced by hospitals activities (SCOPE 1)

Production of good and services for hospitals (SCOPE 3)



Slide provided by TNO, RES-Hospitals Partner

These basic observations
Show
How crucial Hospitals are
In the "great challenge of the 21st century"
For the same reason, this is
how the Energy Efficiency and the
use of Renewable Energy Sources
Is an important factor for
Health Infrastructure Strategic Planning

These basic considerations
Have originated the project
RES – Hospitals *
Toward Hospitals at Zero Emissions
Aimed to
Explore non-technical barriers
For the exploitation of Energy Efficiency Measures
and
Use of Renewable Energy Sources

***European Project - Sponsored by the "Intelligent Energy for Europe Programme "**

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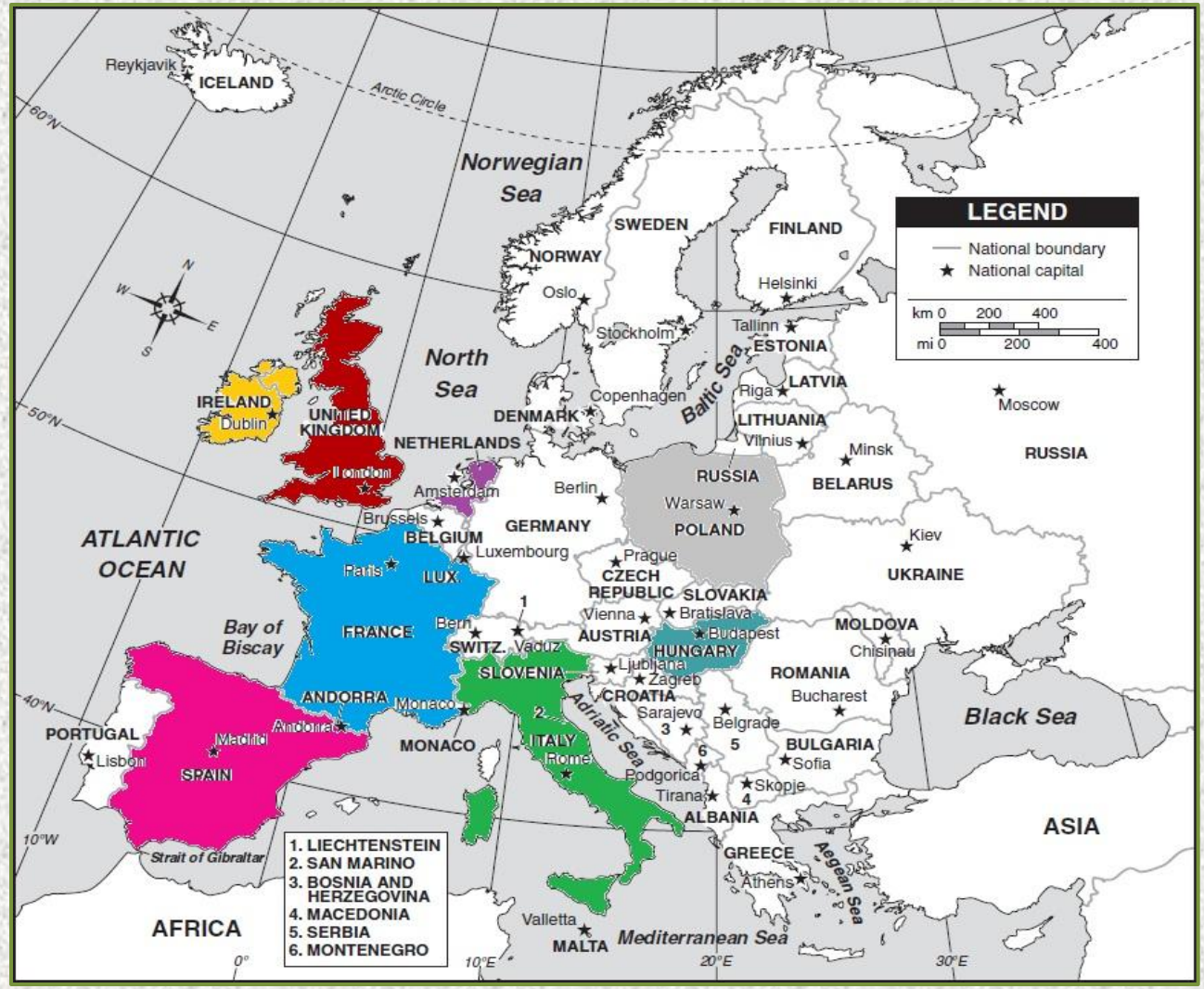
INTELLIGENT ENERGY EUROPE FOR A SUSTAINABLE FUTURE

ABOUT THE PROJECT

COUNTRIES INVOLVED

- FRANCE
- ITALY
- HOLAND
- IERLAND
- UNITED KINGDOM
- POLAND
- HUNGRY
- SPAIN



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Pilot projects in the eight European countries

Aimed at exploring the barriers and how they can be overcome in different situations to have for the hospitals

- Zero carbon possibilities
- Investment plan to reach 50% RES by 2020

RES Guide for European Hospitals

Aimed at technical, management and policy stakeholders

- Influencing factors
- Non-technical barriers
- Feasible RES options
- Making the business case for investment

The survey carried on among hospital's administrative and technical managers highlighted:

Key non-technical barriers

Finance-related
Lack of capital budgets for investment
Investment payback rules are too short
Lack of public sector incentives

Strategy-related
Lack of long term focus on energy use
Lack of connection to EU and national RES targets
Limitations on the role of hospitals as energy providers
Hospitals risk averse regarding intermittency of energy supply

Indicators for the Calculation of the ecological footprint (2011):

1,956 kg	of CO2	per m3 of methane
424 g	of CO2	per kWh of electric energy (Italy indicator)
1,37 kWh	of CO2	per m3 of water used/supplied
339 kg	of CO2	per m3 of waste water disposal

EUROPEAN EMISSIONS TRADING SYSTEM

The EU Emissions Trading System (EU ETS) is a cornerstone of the European Union's policy to combat climate change and its key tool for reducing industrial greenhouse gas emissions cost-effectively. EU ETS covers some 11,000 power stations and industrial plants in 30 countries.

Launched in 2005, it works on the "cap and trade" principle. There is a "cap", or limit, on the total amount of certain greenhouse gases that can be emitted by the factories, power plants and other installations (INCLUDING HOSPITALS) in the system. Within this cap, companies receive emission allowances which they can sell to or buy from one another as needed. The limit on the total number of allowances available ensures that they have a value.

At the end of each year each company must surrender enough allowances to cover all its emissions, otherwise heavy fines are imposed.

Reasing Awarness

"I shut off waste"

- Starting in 2008
- Regional campaign of Emilia-Romagna
- All the people working or using health facilities to give their contribution for an appropriate use of energy.
- Distribution in all the the Region health structures of posters Brochures and pannels
- advocating 10 good habits of responsible consumtion

Efficient conversion -Installing energy efficient technology

CAREGGI UNIVERSITY HOSPITAL - FLORENCE

- area 74 hectars – 1,650 beds – 6,000 employees – 15,000 people present daily

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ENERGY AND ENVIRONMENTAL BENEFITS OF TRIGENERATION

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ENERGY PRODUCTION SYSTEM PRESENT AND FUTURE

CURRENT SITUATION

HEAT: Steam generators with existing distribution network, partly in tunnel and underground

ELECTRICITY: From the ENEL network through 9 local substations

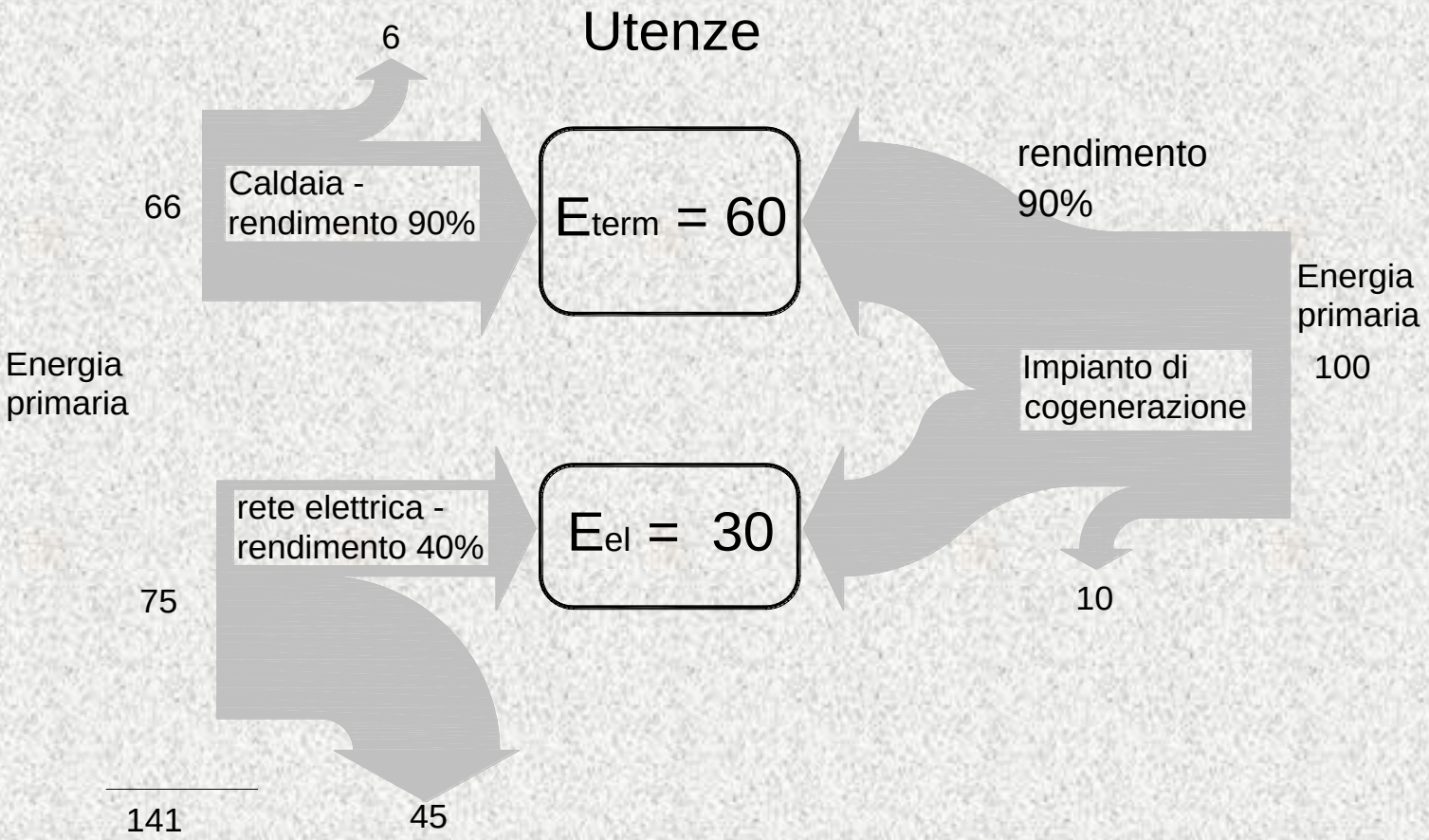
FUTURE

HEAT: boiler heat recovery steam from gas turbine (18 MW) -Steam generator integrative (11MW) - Two additional full backup generators

ELECTRICITY: GE10 gas turbine electric generator (10 MVA) - Network ring in the complex internal MT - Parallel with ENEL network

ENERGY COOLING: double effect absorption chillers to the potential of 6.3 MWF.

COGENERATION - CHART OF SANKEY

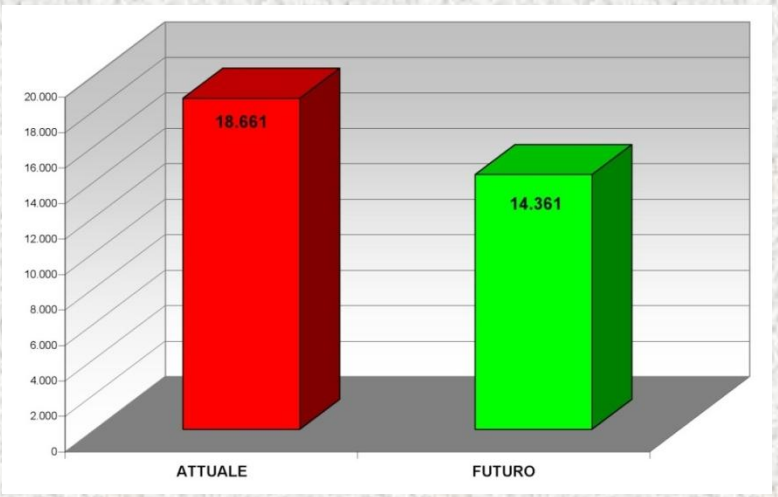


ACHIEVABLE ENERGY SAVING

Sigla	Descrizione	Attuale tep/anno	Futuro tep/anno
	ENERGIA TERMICA		
EP-cal	Energia primaria combustibile caldaie	10.007	1.092
EP-cog	Energia primaria combustibile cogeneratore	-	20.192
EPt	Energia primaria totale immessa con il combustibile	10.007	21.284
	ENERGIA ELETTRICA		
EPe-rete	Energia primaria associata all'en. elettrica prelevata	8.662	963
EPe-imm	Energia primaria associata all'en. elettrica immessa	-	- 7.887
EPe	Bilancio energia elettrica primaria risultante	8.662	- 6.924
EP-totale	**Energia primaria complessiva risultante**	18.669	14.361
R	**Risparmio energia primaria ottenibile**		4.308
IRE	**Indice di risparmio percentuale**		23,1%

EXPECTED ENERGY SAVING PER YEAR 23,1%

COMPARISON PRIMARY ENERGY TOTAL (tep/year)



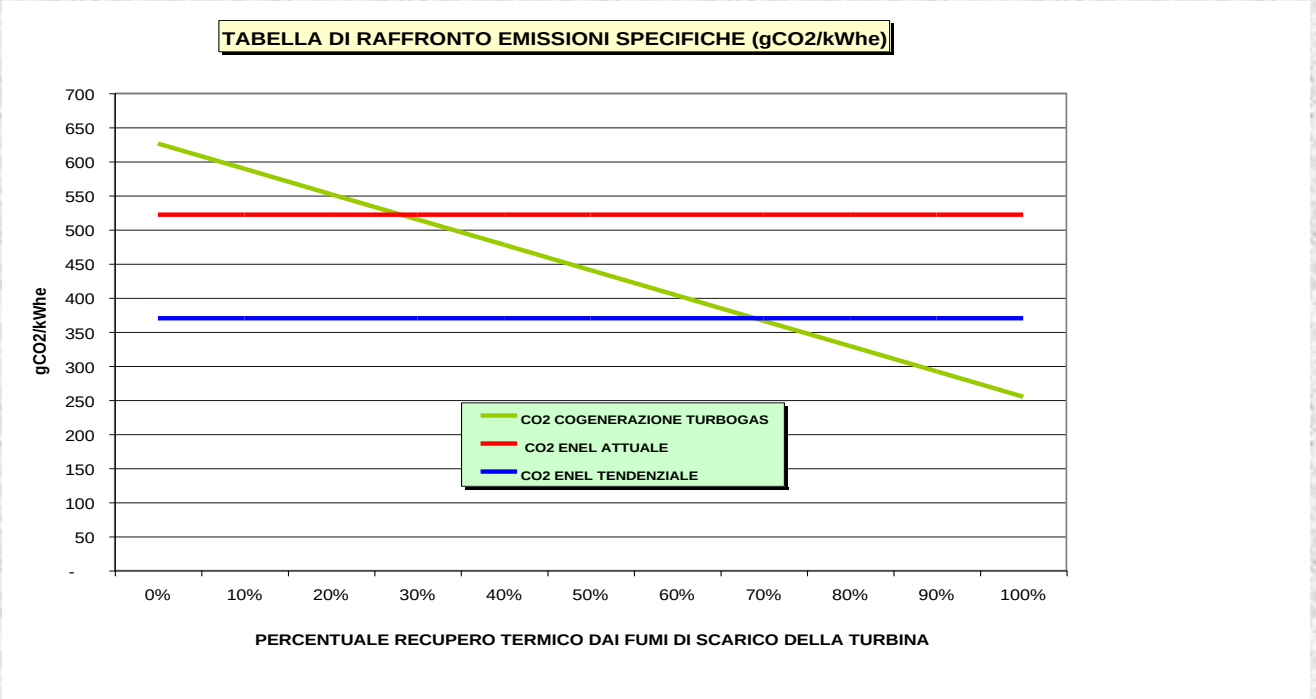
EMISSIONS INTO THE ATMOSPHERE

Design approach, which seeks to identify the optimum size of the cogeneration system, has placed in the foreground the measurement of the production of CO2 equivalent, which represents the parameter of comparison with regard to the greenhouse effect induced.

The CHP identified (gas turbine) has reference values under nominal maximum power of 33% compared with average yields of Enel power plants (around 45%) would lead to a significant disadvantage from the point of emission of greenhouse gases.

The electrical efficiency gap must therefore be evaluated along with the effectiveness made by the combined production of thermal energy, or the saving of the CO2 previously, directly related to the thermal energy recovered.

The advantage of CHP is therefore directly linked to the **percentage of actual recovery of wasted heat** that must be as high as possible. Based on the previous values, a first comparison of the production of CO2 per kWh produced, in the traditional way and with the cogeneration



From the analysis of the diagram is a clear improvement of CO2 emitted in the event of even with cogeneration of thermal recovery percentage actually used already higher than 40% of the maximum available. The comparison with the specific CO2 emission data, expected future values of ENEL the European average, shows an improvement with recovery rates above 70%.
Operational considerations estimated for the system in question guarantee a percentage of the available heat recovered more than 80% and therefore certainly improvements even in the period in the medium / long term.

EVALUATION OF CO2 AVOIDED WITH CHP

To evaluate the reduction of emissions on an annual basis, reference was made to the energy balance of the PO planned to 2008, comparing the following assumptions in supply:
from traditional sources (electricity and heat from boilers ENEL)
with cogeneration (electricity and heat produced in-house, with partial use of traditional sources for additions)
For homogeneous comparison it was assumed that the fuel used is always the methane hypothesis using other fuels in the solution "traditional" for boilers, would be further penalized for this situation.
The framework for comparison, prepared on the basis of the coverage efficiency of PO Relative to the above situations, is reported in the following table:

QUADRO DI RAFFRONTO EMISSIONI DI CO2 IN ATMOSFERA (CON EMISSIONI DA RETE ENEL 522 gCO2/kWhe				
		TRADIZIONALE	CON TRIGENERAZIONE	DIFFERENZA
PRODUZIONE CO2 DA COMBUSTIONE TURBINA	(t/anno)	0	34.395	34.395
PRODUZIONE CO2 DA COMBUSTIONE CALDAIE	(t/anno)	21.015	7.684	-13.331
PRODUZIONE CO2 DA RETE ENEL	(t/anno)	20.589	-7.707	-28.296
PRODUZIONE DI CO2 TOTALE	(t/anno)	41.604	34.372	-7.232 -17,4%

DATI DI RIFERIMENTO APPLICATI:
Produzione CO2 da combustione metano *1,898 kg/Smc*
Produzione CO2 da rete ENEL *0,522 kg/kWhe*

In the calculation of comparison, in addition to the thermal recovery, iti s also considered the lack of production of CO2 by ENEL, the proportion of electricity sold in the network.

The quantity of CO2avoided equal to 7232 t / year, corresponds to a percentage reduction of 17.4%.

ENVIRONMENTAL ADVANTAGES

In terms of energy savings, the implementation of the intervention, will generate savings of fossil energy equivalent of 23% (about 4,300 toe/ year).

With regard to the emissions, it will avoid the emission into the atmosphere, in a particularly sensitive urbanized areas, approximately of:

- *7.232 tonn./anno di CO2* ***(carbon dioxide)***
- *133 tonn./anno di SO2* ***(sulfur dioxide)***
- *80 tonn./anno di NOx* ***(Oxides of Nitrogen)***
- *24 tonn./anno di PM10* ***(fine dust)***

Onsite Renewable Energy

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PLANNING AND IMPLEMENTING RES AT GIRVAN COMMUNITY HOSPITAL

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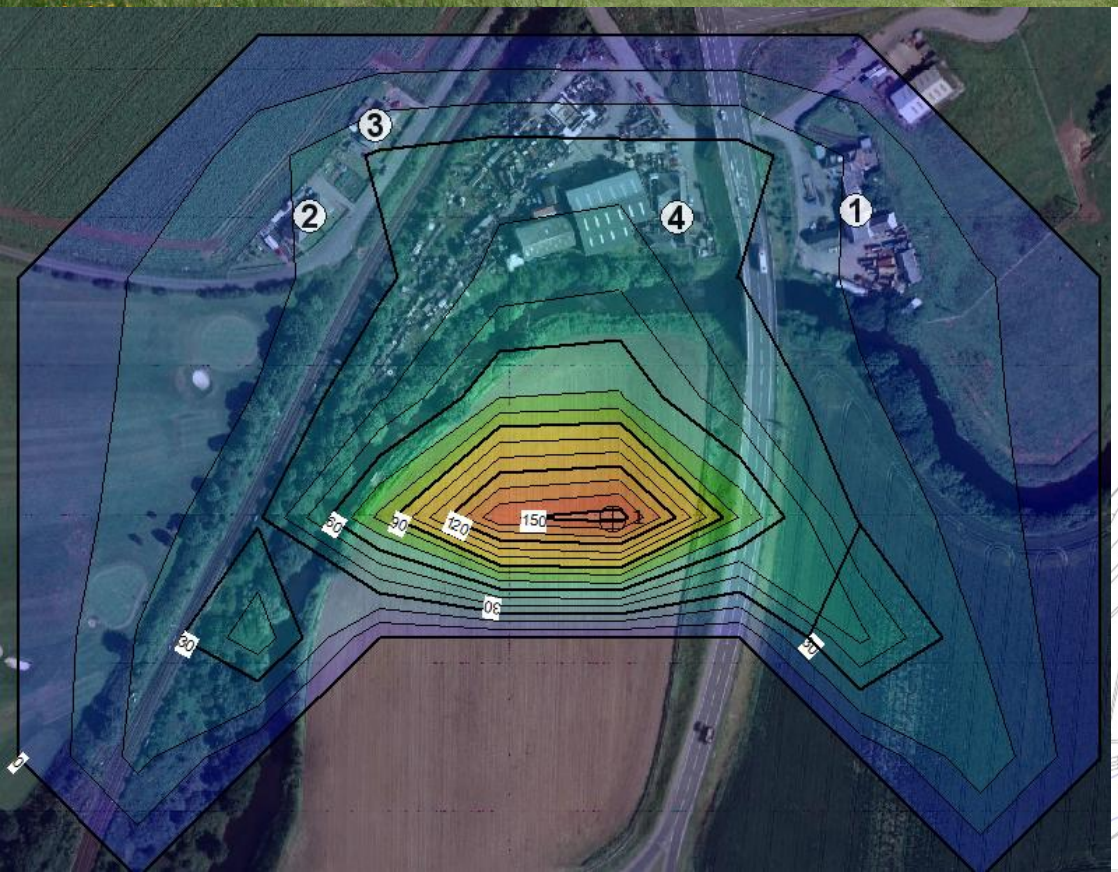
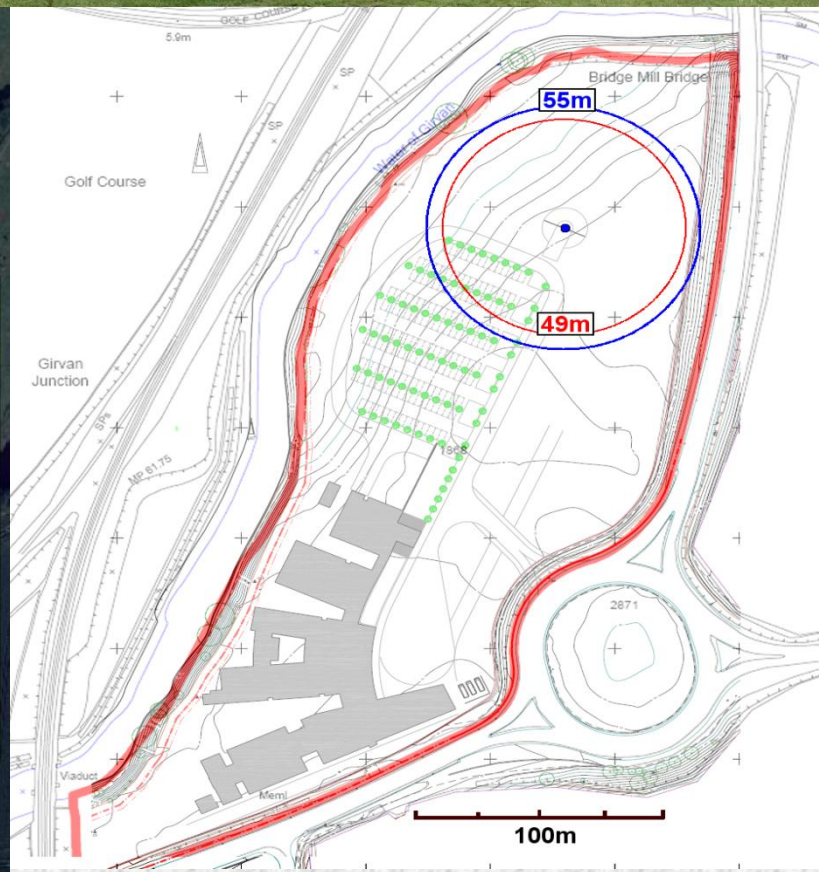

3
2
4
1
30
60
90
120
150
30
30


55m
49m
Golf Course
Girvan
Junction
Bridge Mill Bridge
Viaduct
100m

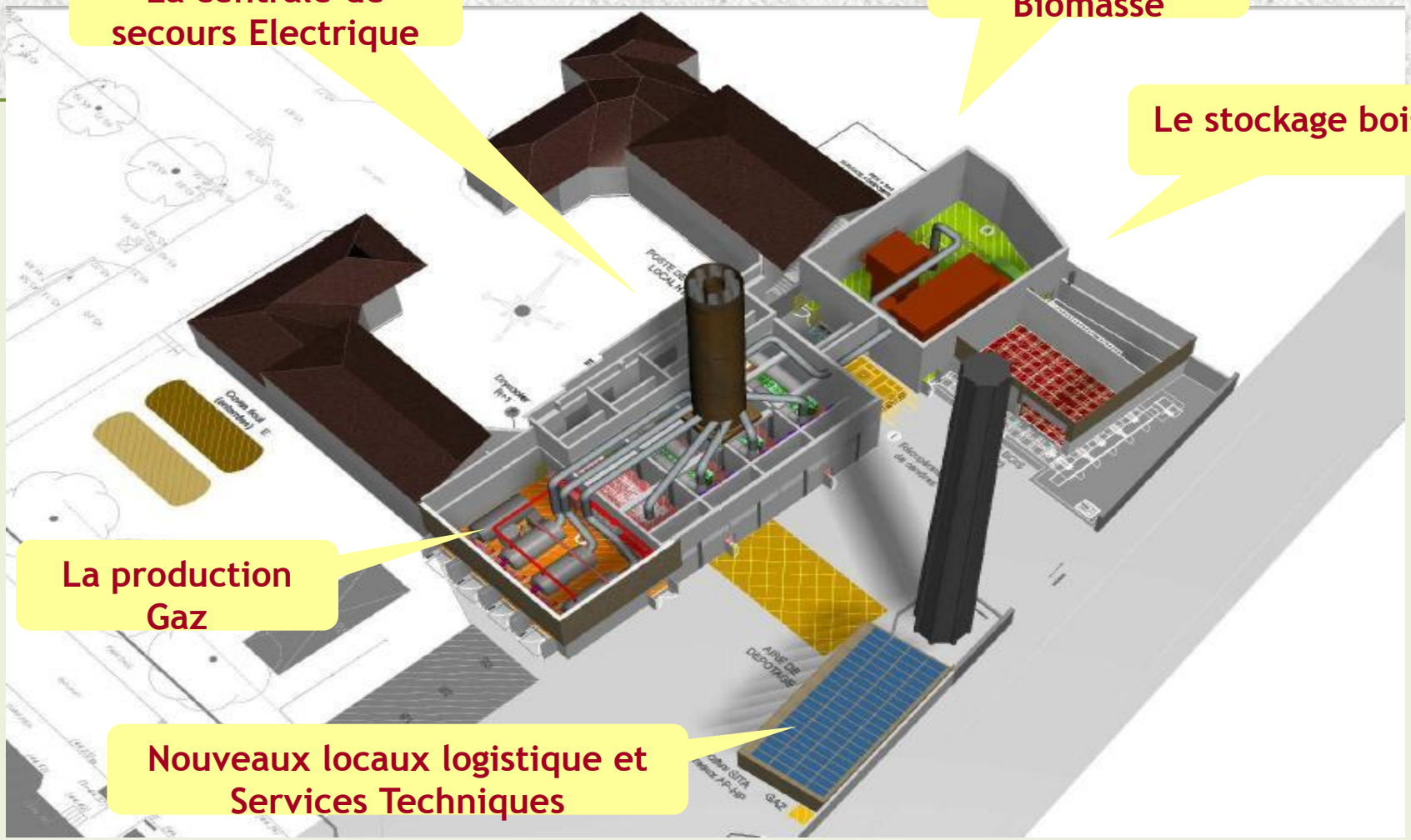
AVICENNE HOSPITAL - FRANCE

PERFORMANCES ENERGETIQUES, ENVIRONNEMENTALES ET ECONOMIQUES

1. Les principaux équipements techniques

- **1 chaudière bois de 2900 kw (1500 kg bois/heure)**
- Silo de cendre de 8 m^3
- **3 chaudières fuel/gaz** de 3000 kw unitaires dont une totalement en secours
- 17 sous-stations de chauffage
- 1 postes de livraison d'électricité 15000 v
- 6 postes de transformation HT-BT
- 1 ensemble de cellules HTA et un dispositif de reconfiguration de boucle
- 3 groupes électrogènes de 2000 kva unitaires
- Stockage fuel = 2 cuves de 60 m^3
- 1 cheminée de 25 m de hauteur et de 2,65 m de diamètre contenant 8 conduits de fumée (7+1 extension)

THE NEW PROJECT


La centrale de secours Electrique
La production Biomasse
Le stockage bois
La production Gaz
Nouveaux locaux logistique et Services Techniques

PERFORMANCES ENERGETIQUES, ENVIRONNEMENTALES ET ECONOMIQUES

- **Les aspects financiers**
  - 12 M € TDC d'investissement
  - **0,9 M € TTC/an** loyers investissement
  - **1,04 M € TTC/an** loyers exploitation et fourniture d'énergie, durée du CP = 21ans
  - Investissement incluant une nouvelle voie de circulation.
  - Prix du kwh chaleur inférieur de 40 % au gaz.
  - La subvention de la Région et de ADEME représente 25 % de l'investissement bois/gaz.
  - Des formules de pénalités financières très incitatives pour le PP en termes de continuité de service, de rendements et performances énergétiques.

ENVIRONMENTAL RESULTS

- **Emission de CO^2 :**
- Gaz : 205 g CO2 eq / kWh pci
- Gazole : 270 g CO2 eq / kWh pci => Camion PL : 500 g CO2 eq / km
- Biomasse : 0

• Besoins Actuels « tout gaz » (21.900 MWh pcs/an)	4.038	tonnes CO2 eq/an
• Besoins futurs « tout gaz » (33 900 MWh pcs/an)	6.252	tonnes CO2 eq/an
• Besoins futurs « mix Biomasse/gaz (66 % biomasse)	1.750	tonnes CO2 eq/an

HOSPITAL OF AVICENNE

VERSILIA HOSPITAL-TUSCANY

TOTAL LAND AREA ABOUT 11 hectares

TOTAL COVERED AREA ABOUT 25,000 square metres

TOTAL BUILDING FLOOR AREA 69,000 square metres

NUMBER OF BEDS: 400
PLUS
BEDS FOR DAYHOSPITAL : 80

BUILDING HEIGHT 17.50 metres

HEIGHT OF PINES TREES 19.00 meters

VERSILIA HOSPITAL - TUSCANY

Photovoltaic panels generating 198,72 Kw, partially conveyed into the grid, as energy efficient.
A new plan photovoltaic panels up to the production of 500 Kwp, mini-windmill are being planned.

The "Versilia" is the only Italian Hospital that as obtained the level "C" of energy efficiency, thanks to:

- Thanks to the highly energy efficient building, monitored by a computerized Building Management System,
- Photovoltaic panels generating 198,72 Kw, partially conveyed into the grid,
- modern illumination energy-saving systems with fluorescent electronic ballasts, with internal automatic on and off systems (switches presence) and external (crepuscolar switches)
- recovery of the heat through reverse-flow heat exchangers.
- "free cooling" using fresh air of the environment too cool down the water of the ventilation plant and cool down the building (passive cooling)
- variable frequency inverters for the regulation of the number of revolutions for machinery such as pumps, ventilators etc.
- Thermal insulation with mineral wool or polystyrene of the network distribution of hot fluids and hot/cold.

Additional investment in photovoltaic and new innovative plant will further reduce the CO_2 emissions and will allow Versilia to reach "B" level of ENERGY EFFICIENCY.

These are a few of the examples
of the Hospitals moving towards
at least 50% of production
of their energy needs
through onsite production
With RES

Now the big question

Is it possible for Hospitals

To achieve

Zero Carbon ?

What does

"ZERO CARBON"

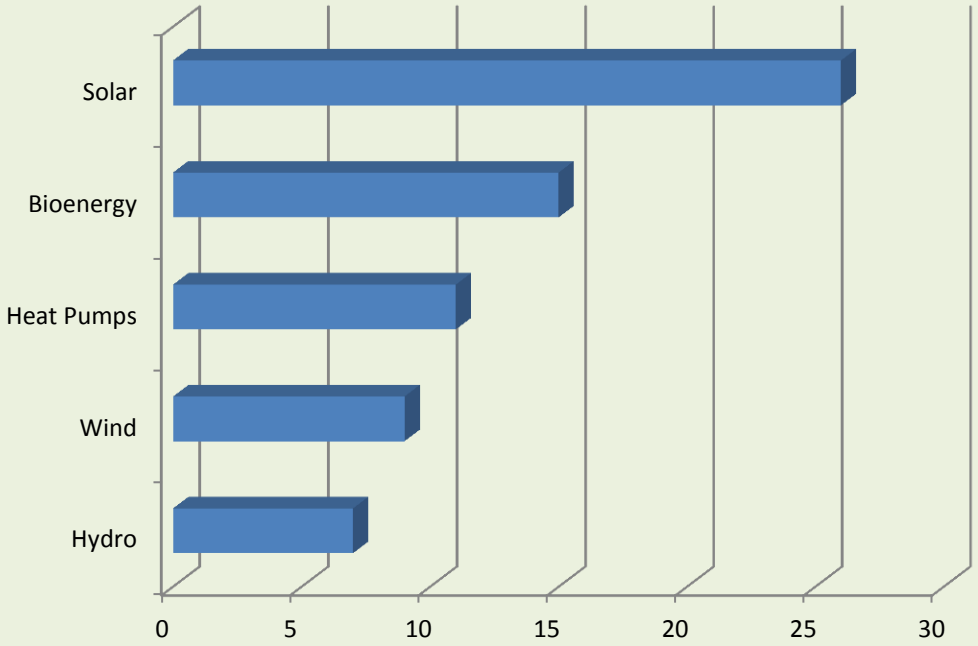
Mean?

Direct & indirect emissions from the hospitals site (Scope 1),

from energy produced by 3rd parties (Scope 2)

and from the hospital supply chain (Scope 3).

CURRENT POSITION/OPTIONS FOR HOSPITALS



See www.res-hospitals.eu for summary of examples (v1)

WHAT ABOUT THE FUTURE

WHAT WE EXPECT

41% increase in gas prices (2010-2020)

31% increase in industrial electricity prices (2010-2020)

biomass investment costs will increase by 41% (2000-2030)

BAD

GOOD

Investment costs for PV modules will decrease by 74% (2000-2030)

onshore wind investment costs will decrease by 5.23% (2000-2030)

DIRECT EFFECT

EU Emissions Trading Scheme currently affects some hospitals

DIRECT EFFECT

The Intergovernmental Panel on Climate Change (IPCC), together with many authoritative bodies

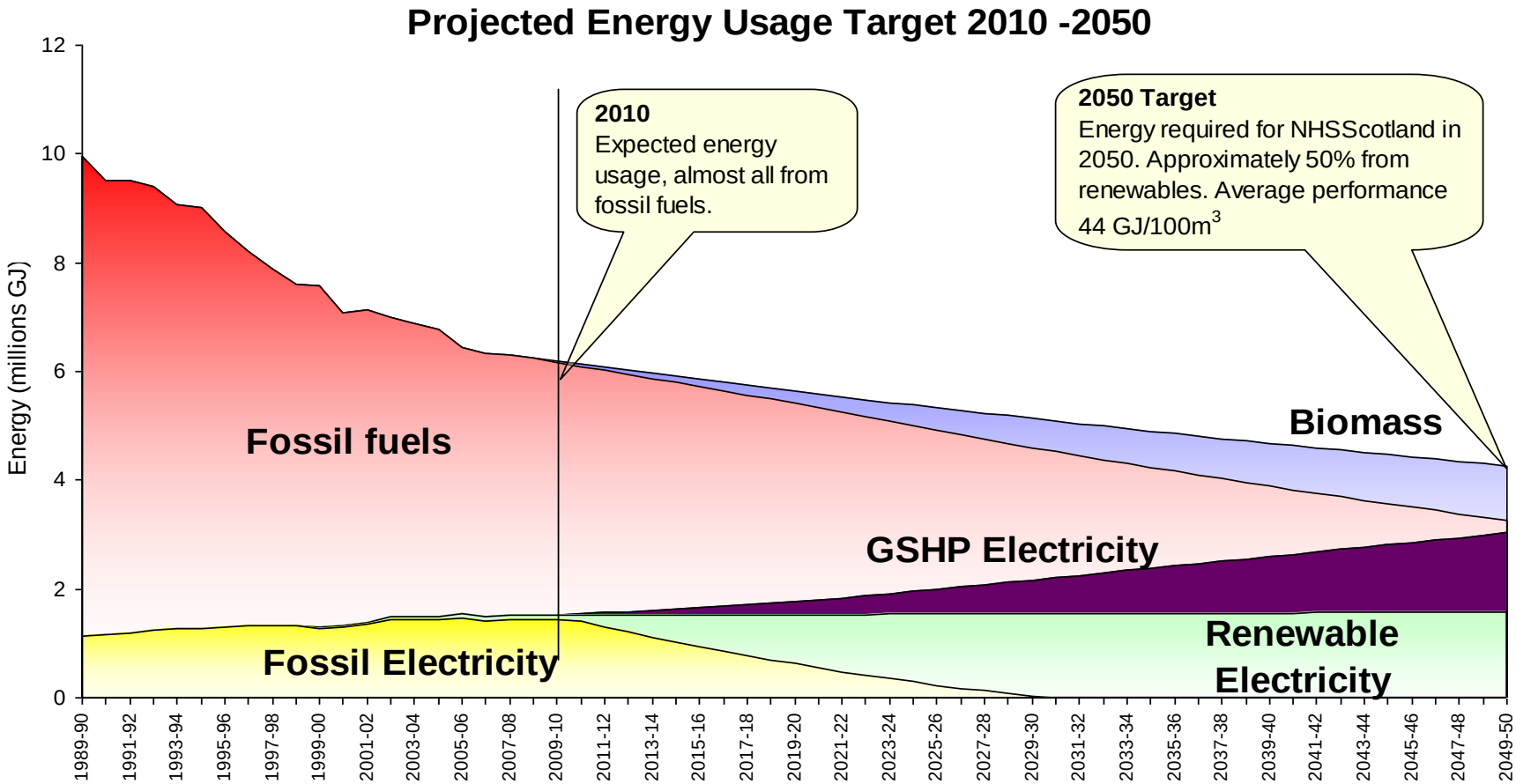
predict a continuous increase in the RES applications.

Innovation will bring new possibilities.....

SCOTLAND

Scotland offers an example of efficient and determined CO2 fighter

ESTIMATED ENERGY USAGE BY 2050:



What about our 15,000 existing hospitals of Europe?

One part of these will be replaced, hopefully with efficient new facilities powered mostly with RES

What about the others?

There is no doubt scope 2 (energy produced by 3rd parties)

and scope 3 (the hospital supply chain)

constitute an engagement that the hospital can advocate

needing however a larger society and community involvement.

And many other

European and non European Hospitals

WILL

Reach ZERO CARBON

As result of community

General policies

Of research and development

Of investments

For non-onsite green fuel

These policies however have to be developed

Located in the historic center of Bologna

Anno di costruzione: 1400-1800-1900

Anno ultima ristrutturazione edilizia: 2012

Numero posti letto: 1.653

Superficie complessiva: 297.375mq

Volume complessivo: 1.041.769

Numero di stabili/padiglioni: 31

And this

Has to be

In the Agenda

Of all of us, who work

For planning the strategies

for the Health infrastructures

THANKYOU FOR YOUR

ATTENTION!!